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(54) Title: GENERATING ELECTRICITY

(57) Abstract: There is disclosed an electricity-generating arrangement comprising an electricity generator and a power arrangement for the same using a variable renewable energy source, the generator being connected to supply an electricity demand and an electrolyser producing fuel from electrical power surplus to instantaneous demand, and a fuel using arrangement adapted to convert said fuel to electricity supplementary to said generator to supply excess demand.

Generating Electricity

This invention relates to generating electricity.

Electricity can be generated from so-called renewable energy sources, such as wind and wave power and solar radiation. Improvements in efficiency brought about by better engineering and technology have made the use of renewable energy sources more attractive, economically, and visible evidence of this is in the increasing number of wind farms coming into operation in recent times. The cost per unit of electricity generated has fallen steadily to a point where wind power can compete with more conventional means of generation, such as coal and oil-fired generators, and the renewable energy source has the advantage of being eco-friendly, if noise and landscape blight are left out of the equation. Certainly, no greenhouse gases are released, and there is no long term problem of storage of radioactive waste and no risk of fissile materials falling into the wrong hands.

Problems remain, however, with renewable energy sources, in that they are not constantly available. Even when sited in optimum wind regime locations, there are days when wind turbines are becalmed, as well as days when the wind is too strong for safe operation, and similar consideration apply to wave and solar power. So, there has to be back-up power from conventional generating plant, and wind power is seen still as merely a useful adjunct to conventional generation.

The present invention provides a solution to the problem of the variability of renewable energy sources.

The invention comprises an electricity-generating arrangement comprising an electrical generator and a power arrangement for the same using a variable renewable energy

source, the generator being connected to supply an electricity demand and an electrolyser producing fuel from electrical power in excess of that used to supply the demand and a fuel using arrangement adapted to convert said fuel to electricity supplementary to said generator to supply excess demand.

The power arrangement may comprise a wind turbine, a wave power arrangement or a solar energy converter.

The generator may be a conventional rotary generator, which may be connected to be driven directly by the power arrangement, or indirectly. An indirect drive arrangement may comprise an hydraulic motor, the power arrangement driving an hydraulic pump. Several wind turbines, for example, may drive hydraulic pumps mounted directly on the axes of the turbines, the pumps being connected to a supply for a single hydraulic motor driving the generator. Such an arrangement, incidentally, will address another problem with wind turbine operation, namely that of noise, to which the conventional mechanical drive train contributes significantly.

The fuel using arrangement may comprise an auxiliary driver for the generator. The auxiliary driver may comprise an internal combustion engine powered by fuel, such as hydrogen, generated by the electrolyser. The engine may be adapted for use also with a fuel, which may be a hydrocarbon fuel such as diesel fuel, other than the fuel produced by the electrolyser.

The hydrogen can be stored under pressure, to reduce storage volume.

The fuel using arrangement may comprise a fuel cell, and the apparatus may then also comprise a static convertor converting dc produced by the fuel cell into ac suitable for the electricity demand.

Embodiments of electricity generating arrangements according to the invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is a diagrammatic representation of a first embodiment; and

Figure 2 is a diagrammatic representation of a second embodiment.

The drawings illustrate an electricity-generating arrangement comprising an electrical generator 11 and a power arrangement 12 for the same using a variable renewable energy source, in this case, wind power. The generator 11 is connected to supply an electricity demand 13, which may be a national or local grid system, or may be a free-standing consumer such as a factory or commercial complex. In Figure 1 the generator 11 has an auxiliary driver 14, and the arrangement has an electrolyser 15 producing fuel for the auxiliary driver 14 from electrical power surplus to instantaneous demand.

The power arrangement 12 comprises a plurality - five are shown, but wind farms of any size may be accommodated - of wind turbines 16, typically of 10m radius. Each turbine 16 is mounted on a tower 17 on a combined thrust and pintle bearing 18. On the shaft 19 of each turbine 16 is mounted an hydraulic pump 21, which can, for example, be a radial piston fixed displacement hydraulic motor, run as a pump. Fluid feed and pressure lines 22, 23, to and from the pumps 21 in the towers 17 and join a common hydraulic circuit including a pressurised oil reservoir 24 and an hydraulic motor 25 which drives the generator 11 via a one way shaft coupling 26.

A control arrangement 27 senses when demand for electricity produced by the generator driven by the wind turbines falls below what the generator can produce, and diverts power to a rectifier 28 which supplies dc current to the electrolyser 15 which generates hydrogen by electrolysis of water. The hydrogen is stored in a container 31, which may

be pressurised. Oxygen will also be produced by the electrolyser, and may be collected or vented as desired.

The auxiliary driver 14 in the form of an internal combustion engine fuelled by hydrogen from the container 31 is connected, again by a one way shaft coupling 33, to drive the generator 11. The control arrangement 27 will sense when demand for electricity exceeds supply powered by the wind turbines, and will automatically cut in the auxiliary driver 14 to provide auxiliary power or, in dead calm conditions, all the power required to supply the demand.

The control arrangement 27 will also provide torque control on the wind turbine rotors to optimise power generation in different wind conditions, and will monitor hydrogen stocks and pressure so as to avoid overproduction of hydrogen in good wind conditions when there is little external demand. Of course, arrangements may be made to bottle hydrogen produced surplus to requirements of the generating arrangement, for use, for example, in vehicles or other equipment.

In the embodiment of Figure 2, the auxiliary power driver 14 is replaced by a fuel cell 41 supplied with hydrogen fluid from the store 31 connected to a static inverter 42 which is connected to the demand 13 though appropriate interface arrangements, not shown.

The arrangement may be made to operate completely automatically, under computer control, and communicate with a central control hub for maintenance scheduling, fault reporting and so forth.

The configuration of the electricity-generating equipment as regards the production capacity of the electrolyser and the hydrogen storage capacity will advantageously take into account the wind regime at the site and the electricity demand pattern.

For periods when insufficient hydrogen has been generated, auxiliary diesel power may be provided, possibly in the form of a dual fuel auxiliary driver.

Whilst electrolytic dissociation of water appears to be simple and inexpensive, it may be that other dissociable and recombinable substances could be used to power the auxiliary driver, while maintaining the eco-friendly nature of water-generated hydrogen, the combustion product of which is, of course, water.

CLAIMS

1. An electricity-generating arrangement comprising an electricity generator and a power arrangement for the same using a variable renewable energy source, the generator being connected to supply an electricity demand and an electrolyser producing fuel from electrical power surplus to instantaneous demand, and a fuel using arrangement adapted to convert said fuel to electricity supplementary to said generator to supply excess demand.

2. A generating arrangement according to claim 1, in which the power arrangement comprises a wind turbine.

3. A generating arrangement according to claim 2, in which the power arrangement comprises a plurality of wind turbines coupled together.

4. A generating arrangement according to claim 2 or claim 3, in which a wind turbine drives an hydraulic pump.

5. A generating arrangement according to claim 4, in which the power arrangement comprises an hydraulic motor driving the generator.

6. A generating arrangement according to claim 1, in which the power arrangement comprises a wave power arrangement.

7. A generating arrangement according to claim 1, in which the power arrangement comprises a solar energy converter.

8. A generator arrangement according to any one of claims 1 to 7, in which the fuel using arrangement comprises an auxiliary driver for the generator.

9. A generating arrangement according to claim 8, in which the auxiliary driver comprises an internal combustion engine powered by fuel produced by the electrolyser.

10. A generating arrangement according to claim 9, in which the internal combustion engine is a dual fuel engine.

11 A generating arrangement according to any one of claims 1 to 10, in which the fuel is hydrogen.

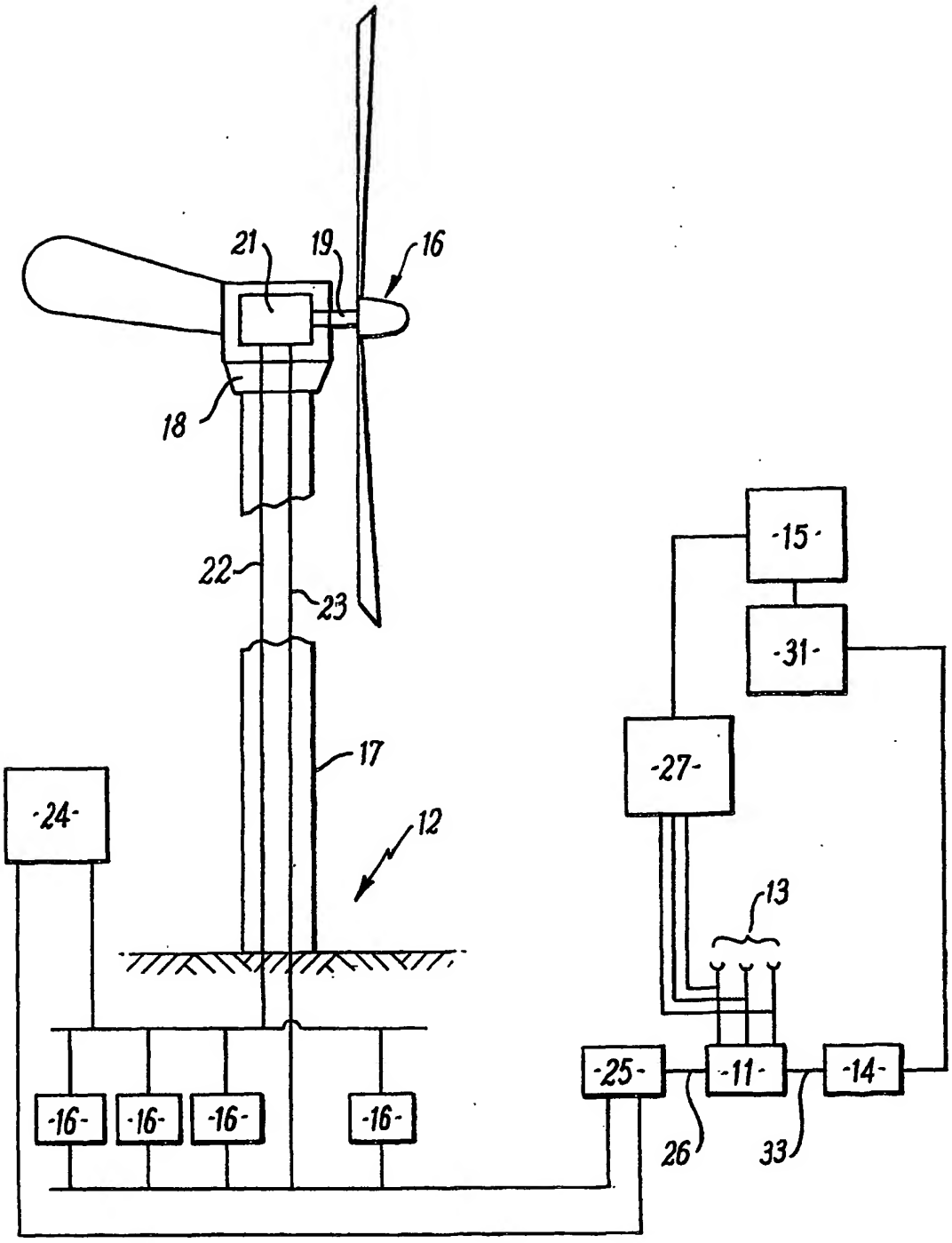

FIG. 1

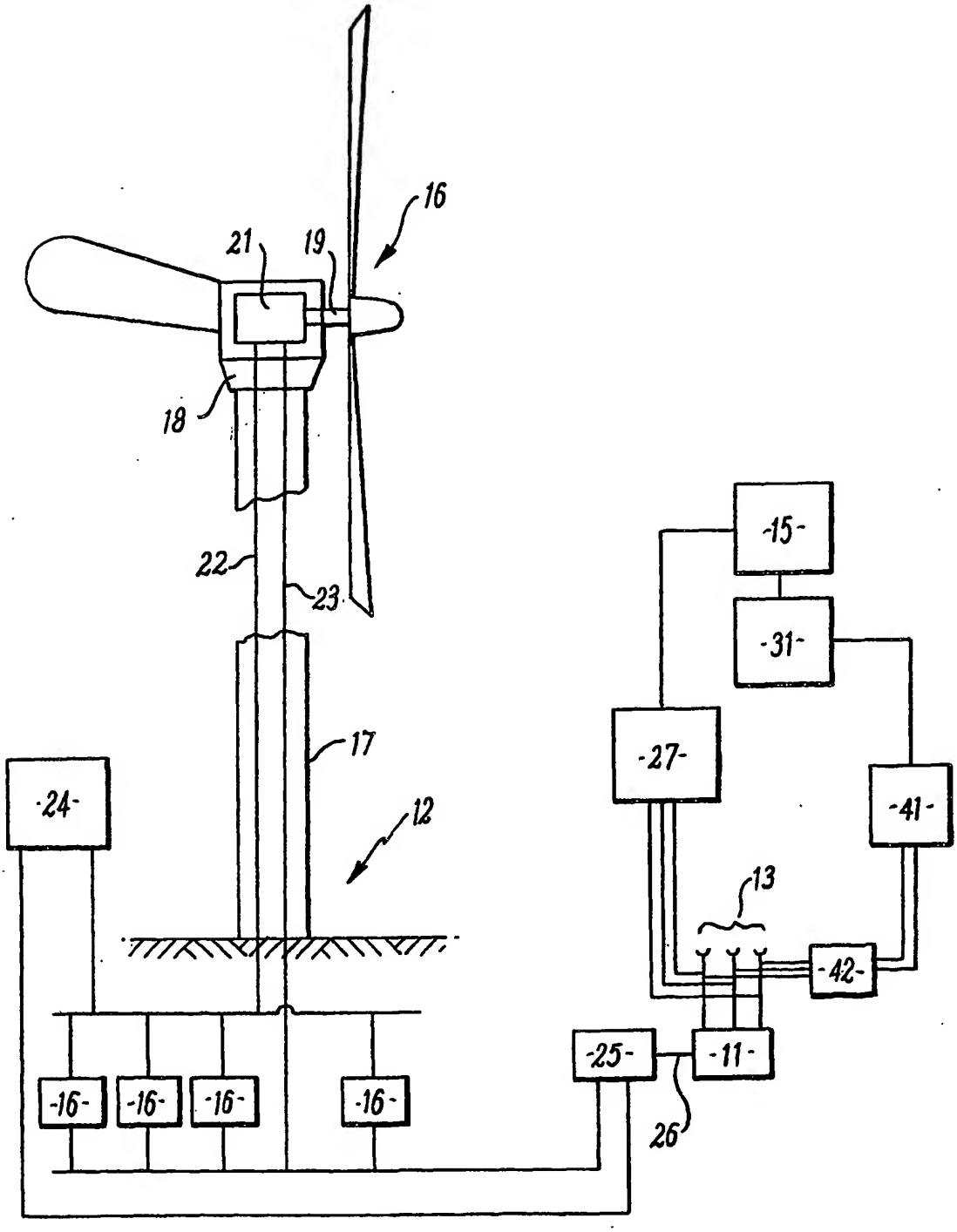

FIG. 2